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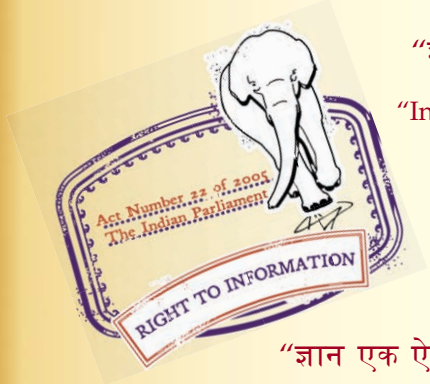
IS 3768 (1996): Ventilation Ducting - Vinyl Coated, Flexible and Semi-Rigid [PCD 13: Rubber and Rubber Products]



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Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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(Reaffirmed 2012)

संवातन वाहिनी — विनायल लेपित नम्य तथा अर्धदृढ़ — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

VENTILATION DUCTING — VINYL COATED, FLEXIBLE AND SEMI-RIGID — SPECIFICATION

(Second Revision)

ICS 73.100.20

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1996

Price Group 6

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Rubber Products Sectional Committee, had been approved by the Petroleum, Coal and Related Products Division Council.

Ducting made from coated fabrics are used in mines for auxiliary ventilation. Flexible ventilation ducting is suitable for forcing systems only, whereas semi-rigid ventilation ductings may be used for both exhausting as well as forcing systems. The concerned committee had originally formulated the following two standards on the subject:

i) IS 3768 : 1966 Ventilation ducting — Vinyl coated, flexible — Specification

ii) IS 12814 : 1989 Ventilation ducting — Vinyl coated, semi-rigid — Specificattion

IS 3768 : 1966 was revised in 1989 incorporating changes in the requirements of finished fabrics and joint rings and additional requirements of tear strength and electrical resistance while requirement of mass of base fabric was deleted.

While taking up subsequent revisions of both the above standards, it was felt that both the standards may be suitably amalgamated into one and, therefore, it has been decided to merge the finalized draft revision of IS 12814 in the second revision of IS 3768. Accordingly, in this revision, the scope has been enlarged so as to cover both flexible and semi-rigid ventilation ducting.

In this second revision, keeping in mind the safety aspect of the ductings, requirements for mass per unit area, tensile strength, tear strength and strength of welds have been upgraded to keep in line with current trade practices as well as the quality maintained internationally for ventilation ductings. Since durability of ductings is directly related to the tear strength of base fabric and ductings are most vulnerable to abrasion rather than tensile forces in mine, gsm of the base fabric has been raised along with improved tear strength requirement.

Two new requirements, coating adhesion and flex resistance have also been incorporated in this revision to have an idea of durability of the product and to know the likely behaviour of the product on ageing.

The electrical resistance test has been modified stating that electrical resistance in the material shall be achieved by incorporation of suitable antistatic ingredients in the composition and not by surface treatment as the experience has shown that surface treatment do not last longer and coating generally comes off on abrasion.

The Committee also felt the need to include a requirement for density of smoke and toxicity of smoke/flame in the standard particularly due to burning of vinyl coated ventilation ducting as the asphyxiation sometimes becomes more fatal than actual fire in the mines. In the absence of the required test method data and parameter, the Committee decided to include the same at a later date when enough data is available on the issue. However, it is the responsibility of the manufacturer to ensure that the ingredients which are known to give toxic fumes on burning shall be excluded from the composition of the material.

Ductings of higher sizes with nominal diameter 1 000, 1 100 and 1 200 mm are also reported to be produced. However in the absence of other technical details regarding constructional and functional requirements, these have not been included in the standard for the time being.

In the preparation of this standard considerable assistance has been derived from the following International Standards:

DIN 21605 : 1990 Auxiliary ventilation for mining; flexible plastics air ducts for exhaust and forced ventilation; sprial air ducts. Deutsches Institut für Normung.

DIN 21612 : 1986 Auxiliary ventilation for mining; cladding mateial for flexible air ducts; requirements, testing. Deutsches Insitut für Normung.

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Indian Standard

VENTILATION DUCTING — VINYL COATED, FLEXIBLE AND SEMI-RIGID — SPECIFICATION

(Second Revision)

1 SCOPE

This standard prescribes the requirements, methods of sampling and tests for vinyl coated flexible and semi-rigid ventilation ducting used for auxiliary ventilation in mines.

2 NORMATIVE REFERENCES

2.1 The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
2244 : 1972	Glossary of terms relating to treated fabrics (*first revision*)
7016	Methods of test for coated and treated fabrics :
(Part 2) : 1981	Determination of breaking strength and extension at break (*first revision*)
(Part 3) : 1981	Determination of tear strength (*first revision*)
(Part 4) : 1987	Resistance to damage by flexing (*first revision*)
(Part 5) : 1987	Determination of coating adhesion strength (*first revision*)

3 TYPES

3.1 The ventilation ducting shall be two types namely Flexible Ventilation Ducting and Semi-rigid Ventilation Ducting. The first one is suitable for use in forcing system only while the second one is suitable for both exhausting and forcing systems.

4 TERMINOLOGY

4.1 For the purpose of this draft, the definitions given in IS 2244 : 1972 shall apply.

5 REQUIREMENTS

5.1 Dimensions

5.1.1 *Internal Diameter*

The diameter of the ducting shall be within the tolerance shown in Table 1.

Table 1 Tolerance for Internal Diameters

Sl No.	Nominal Diameter mm	Actual Diameter at the Joint Ring	
		Maximum (mm)	*Minimum* (mm)
(1)	(2)	(3)	(4)
i)	300	308	302
ii)	400	410	404
iii)	500	511	505
iv)	600	612	606
v)	760	765	759
vi)	900	918	911

5.1.2 *Length*

5.1.2.1 Flexible or semi-rigid ventilation ducting shall be supplied in 5, 10, 15 or 30 m lengths (or as agreed to between the buyer and the seller) measured between the outside edges of the joint-rings. When fully extended, the tolerance on the length of the ducting shall be +100 mm. A tolerance of +200 mm shall be permitted for ducting having more than 15 m length.

5.2 Quality of Materials

5.2.1 *For Both Flexible and Semi-rigid Ventilation Ducting*

i) The fabrics used for making ductings shall be made from non-cellulosic yarn, such as, nylon, polyester or glass fibre.

ii) Both sides of the fabric shall have an adequate coating of polyvinyl choloride and its copolymers which impregnate the interstices of the weave. There shall be good adhesion between the fabric and the coating.

5.2.2 *For Semi-rigid Ventilation Ducting*

Semi-rigid ventilation ducting shall also have a supporting steel wire spiral. The steel wire spiral shall be of normal pitch and close pitch. The normal pitch supporting spiral shall be of 150 mm pitch and close pitch supporting spiral of 75 mm. The steel wire used in the spiral for 900, 760 and 600 mm diameter ducting shall have a minimum diameter of 5.38 mm and in all other sizes, a minimum-diameter of 3.25 mm. The wire shall be suitably coated to minimize corrosion and shall have a tensile strength in the range 13 900 to 15 440 kg/cm^2.

5.3 Construction

5.3.1 No part of the ducting shall be made of an alloy containing aluminium, magnesium or titanium except alloys containing light metals which are permitted for use underground in coal mines.

5.3.2 The ends of the ducting shall be secured round the joint rings without the formation of rucks or creases.

5.3.3 Provision shall be made for suspension of the ducting by approved means which shall require the suspension to be made from the wire spiral, in case of semi-rigid ducting. In case of Flexible ducting, brass eyelets having internal diameter of 6 to 10 mm shall be fitted to the ducting at an interval of not more than 1 m and not more than 100 mm from each joint-ring.

5.3.3.1 Improved types of suspension arrangements, such as, coat-hanger, or any other suitable type may be fitted to the flexible ducting subject to agreement between the manufacturer and the buyer. A suitable design of coat-hanger suspension is shown in Fig. 1.

NOTE — Profile made for coat-hanger suspension shall be made from flame-resistant PVC composition using virgin PVC and other compounding materials of best trade quality.

5.3.4 All welded seams shall be so formed and made as to minimize leakage.

5.3.4.1 The joints and seams on each length of ducting shall be either welded or joined/cemented with suitable material which are fire-resistant in nature.

5.3.4.2 A test piece taken on the welded joint and when subjected to tensile strength as specified in 5.5.1 at right angle of the weld, the minimum breaking force for a sample of 50 mm wide shall not be less than 1 300 N.

5.3.5 In case of semi-rigid ducting, the wire used for the spiral shall be continuous, securely attached on the outside of the ducting and be protected on the outside by either a scuffing strip or other suitable means, and so used to ensure that the semi-rigid ducting will maintain its shape in normal working conditions. Each length of semi-rigid ducting shall be constructed in such a way so that it

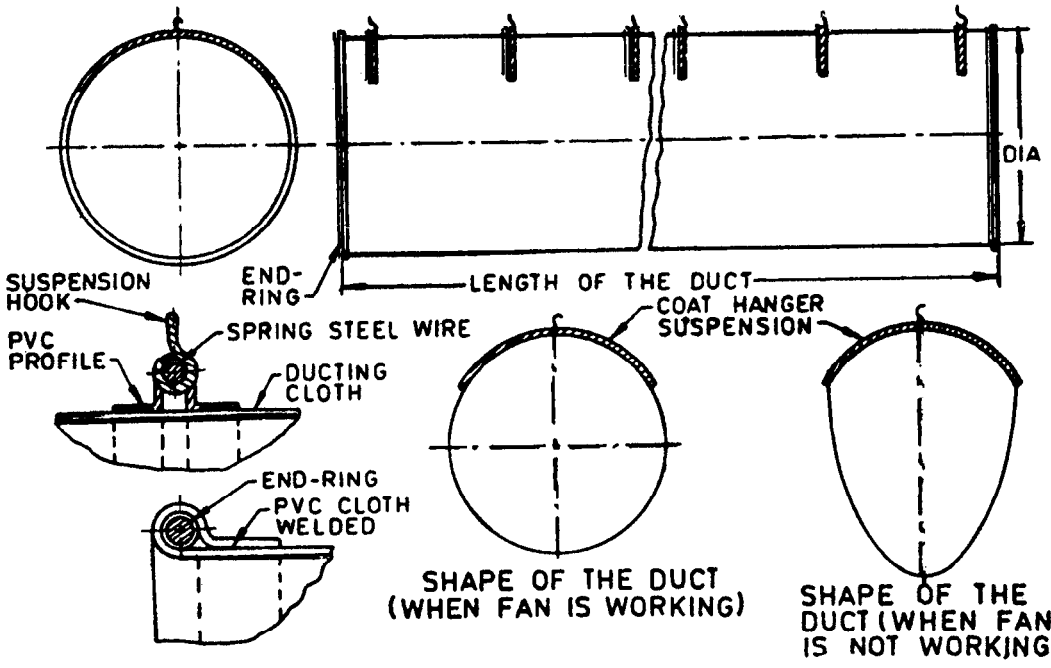


FIG. 1 FLEXIBLE DUCTING WITH COAT-HANGER SUSPENSION

will be concertina (that is, allowing opening out and closing a zigzag manner) to not more than 20 percent of its nominal length.

5.4 Finished Fabrics

5.4.1 The finished coated fabric from which the ducting is constructed shall neither crack, soften or harden nor show any surface deterioration at temperature between 0° and 60°C. The material shall have substantially constant properties within this temperature range.

5.4.2 The minimum mass of the finished fabric shall be 600 g/m^2.

5.5 Performance Requirements

The coated fabric from which the ducting is made shall be subjected to the following tests and shall satisfy the requirements detailed. (If samples of the materials are taken from the complete ducting, they shall be capable of satisfying the same requirement).

5.5.1 *Tensile Strength*

The material shall be tested for tensile strength by means of constant rate-of-traverse testing machine in accordance with IS 7016 (Part 2) : 1981. The rate of traverse shall be 114 ± 12 mm per minute. The minimum breaking force for a sample 50 mm wide shall be not less than 1 500 N for both warp and weft direction.

5.5.2 *Tear Strength*

The warp and weft tear strength shall be not less than 440 N when tested in accordance with Method A-1 of IS 7016 (Part 3) : 1981.

5.5.3 *Electrical Resistance*

Each surface of the material shall be tested for electrical resistance in accordance with the method prescribed in Annex A. When tested by this method, the average value of two resistance measurements made on the upper surface as well as on the lower surface of the material shall not exceed 300 × 10^6 ohms. The required electrical resistance shall be achieved by incorporation of suitable antistatic ingredients in the composition and not by surface treatment.

5.5.4 *Flex Test*

The sample shall pass the flex test for minimum 100 000 cycles when tested as per IS 7016 (Part 4) : 1987.

5.5.5 *Coating Adhesion*

The coating adhesion shall not be less than 30 N in any of the test pieces taken when tested as prescribed in IS 7016 (Part 5) : 1987.

5.5.6 *Fire-Resistance*

5.5.6.1 The finished coated fabric and all other non-metallic materials from which the ducting is constructed shall pass the test when tested in accordance with the method prescribed in Annex B.

5.5.6.2 The choice/selection of suitable test method for fire resistance test may be as agreed to between the buyer and the seller. The test may be conducted by either of the two test methods as agreed to between the buyer and the seller namely, Barthel Burner method or Interim Flame Method. If the buyer so desires the test may be performed on the ductings by both the methods.

5.5.6.3 At least six test pieces shall be tested for fire resistance test. Each of the test piece shall measure 50 mm × 450 mm in size for Barthel Burner method and 76 mm × 356 mm in size for Interim Flame method.

5.5.6.4 The ventilation ducting shall fulfil following conditions if the Barthel Burner method has been used for fire resistance test:

a) The flame or the glow of the material at any time during the test shall not extend above the marker wire.
b) After the burner flame has been removed, neither the mean persistence time of the flame of six test pieces shall exceed three seconds nor the persistence time of the flame on any one test piece shall exceed 10 seconds.
c) After the burner flame has been removed, neither the mean persistence time of the glow of six test pieces shall exceed 10 seconds nor the persistence time of the glow on any one test piece shall exceed 30 seconds.

NOTE — Sometimes it is observed that vinyl coated materials when tested for fire resistance characteristics by Barthel Burner the test pieces melt and break into charred pieces. In such cases where the melting point of the coating material is lower than flame temperature, then flame duration during the test shall be reduced and reported accordingly.

5.5.6.5 The ventilation ducting shall also fulfil the following conditions when tested in accordance with the Interim flame method prescribed in Annex B:

a) After the spirit lamp has been removed, neither the mean persistence time of the flame on six test pieces shall exceed 6 seconds nor the persistence time of the flame on any one test piece shall exceed 12 seconds.

b) After the spirit lamp has been removed, neither the mean persistence time of the glow on six test pieces shall exceed 10 seconds nor the persistence time of the glow on any one test piece shall exceed 30 seconds.

5.6 Assembled Duct

5.6.1 *Pressure Test*

When tested in accordance with Annex C, neither the duct shall pull apart at the joints during the test nor shall it show any signs of tearing or permanent deformation.

5.6.2 *Leakage Test (Forcing)*

The ducting, which has been subjected to the foregoing pressure test (**5.6.1**), shall be tested in accordance with Annex C for leakage test. The rate of air flow into the duct shall not exceed 0.045 D × Lm^3/min, where D and L are diameter and length in m respectively of the assembled ducting.

5.6.3 *Suction Test (For Semi-rigid Ducting only)*

The semi-rigid ducting which has been subjected to the pressure test and leakage test (forcing) shall be tested for suction test in accordance with **C-1.1.3.**

5.6.3.1 The ducting shall not pull apart at the joints during the test and neither shall it show any sign of tearing or permanent deformation.

5.6.3.2 The ducting shall not collapse during the test when tested to the levels shown in Table 2.

5.7 Joint Rings

This test shall be carried out on four rings. A load shall be applied to each ring at right angles to the axis of ducting sufficient to deform the ring into an approximate ellipse having a minor axis not more than 75 percent of the diameter of the circular ring. After the removal of the load, the joint-ring shall not be distorted by more than 1.5 percent of its original diameter in case of all the four rings.

Table 2 Levels for Suction Test
(*Clause* 5.6.3.2)

Diameter mm	Normal 150 mm Spiral
300	473.00 mm of water column, below atmosphere
400	473.00 mm of water column, below atmosphere
500	473.00 mm of water column, below atmosphere
600	448.00 mm of water column, below atmosphere
760	224.00 mm of water column, below atmosphere
900	137.00 mm of water column, below atmosphere
Diameter mm	**Close 75 mm Spiral**
300	722.00 mm of water column, below atmosphere
400	722.00 mm of water column, below atmosphere
500	722.00 mm of water column, below atmosphere
600	647.00 mm of water column, below atmosphere
760	348.00 mm of water column, below atmosphere
900	*228.00 mm of water column, below atmosphere

*Experimental data for size 900 is not available. The estimated value based on data in respect of other sizes is 228. However, this value is subject to agreement between the purchaser and the supplier.

6 PACKING AND MARKING

6.1 Packing

6.1.1 Any suitable method of packing may be used as agreed to between the purchaser and the supplier.

6.1.2 The material shall be securely packed so as to ensure its safe transportation.

6.2 Marking

Each roll of material shall be indelibly marked with following information:

a) Name of the product, that is vinyl-coated, flexible or semi-rigid, ventilation ducting;
b) Indication of source of manufacture;
c) Month and year of manufacture/ manufacturer's batch number.

6.2.1 When packed for delivery, each length of ducting shall be indelibly marked with nominal diameter in mm and the length in m. The marking shall be visible without unpacking or unwrapping the ducting.

7 SAMPLING

7.1 Sampling of the ducting shall be done as prescribed in Annex D.

ANNEX A

(*Clause* 5.5.3)

TEST FOR ELECTRICAL RESISTANCE

A-1 TEST PIECES

A-1.1 Cut two test pieces 300 mm square from the finished fabric.

A-2 APPARATUS

A-2.1 Measuring Instrument

The resistance measuring instrument shall be capable of measuring the range 10^5 ohm (0.1 M ohms) to 10^{10} ohm (10 000 M ohm) and be accurate to within 3 percent of the true value over this range. The potential difference applied between the electrodes during the test shall be between 40 V dc and 1 000 V dc (direct current) and shall be chosen so that not more than 1.0 W is dissipated in the test piece.

A-2.2 Base Sheet

A clean sheet of polythene, or alternative material with resistivity not less than of polythene, shall be used. The base sheet shall not be less than 2.5 mm thick and 300 mm square.

A-2.3 Electrode System

The cylinderical and coaxial brass electrodes, the base of one being circular and the other angular, of dimensions and mass given in Fig. 2 shall be used. The lower surface of each electrode shall be machined flat and shall be polished and clean. Each electrode shall be provided with a flexible insulated lead. The electrode shall have following dimensions:

i) A circular disc 25 mm in diameter; and

ii) A concentric annulus having internal and external diameters of 125 mm and 150 mm respectively (*see* Fig. 3).

Great care shall be taken to ensure accuracy of the dimensions of the electrodes, but the symmetry of the annulus about the centre disc is not critical.

NOTE — The foil electrodes may be used if the sample under test is not sufficiently smooth and flat to enable the liquid contact agent to maintain continuous contact between sample and the brass contact pieces. With irregular surfaces the omission may result in the indicated resistance being higher than the true resistance. In such cases electrode system consisting of brass along with foils may be used.

Suitable foils are as follows:

a) For general use:
Tin on lead (1.5 percent tin, 98.5 percent lead) — 0.025 mm thick, 3.5 m^2/kg, and

b) For indented surface :
Soft tin foil (98.25 percent tin, 1.25 percent antimony, 0.5 percent copper), either 0.005 6 mm thick, 25 m^2/kg or 0.007 6 mm thick, 18 m^2/kg.

A-3 PROCEDURE

A-3.1 Clean the surfaces of the test piece by dusting and rubbing with Fuller's earth using a clean pad of cloth or cotton wool. After all traces of the powder have been cleaned away, wipe the surface with a clean cloth moistened with distilled water and dry it with a clean cloth.

A-3.2 Prior to evaluation, condition the test pieces in a standard atmosphere of 65 ± 5 percent relative humidity and 27 ± 2°C temperature for at least 2 hours and immediately test at that temperature.

A-3.3 On one of the surfaces of the test piece, paint two circles, the dimensions of which are given in Fig. 3 with a liquid consisting of:

a) 800 parts by mass of anhydrous polyethylene glycol of molecular mass 600;

b) 200 parts by mass of water; and

c) 1 part by mass of soft soap.

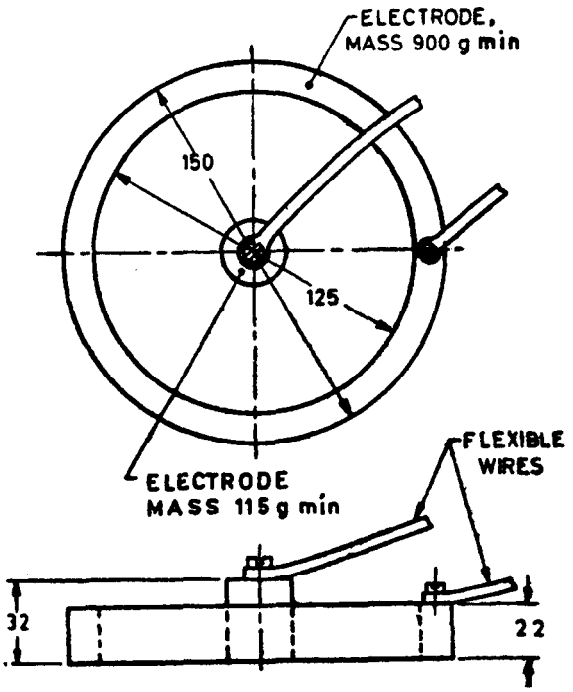
or other conducting liquid having at least the same electrical conductivity.

A-3.4 It is important that the circles should be accurately painted and any excess liquid should be wiped away with a clean cotton wool pad. Ensure that the resistance between any two points on either of the painted rings does not exceed 10^5 ohms; otherwise, discard the test piece and prepare a fresh sample.

A-3.5 Place the test piece on the piece of insulating material, with the painted rings on the top. Clean the lower faces of the electrodes and place these accurately over the painted rings on the test piece.

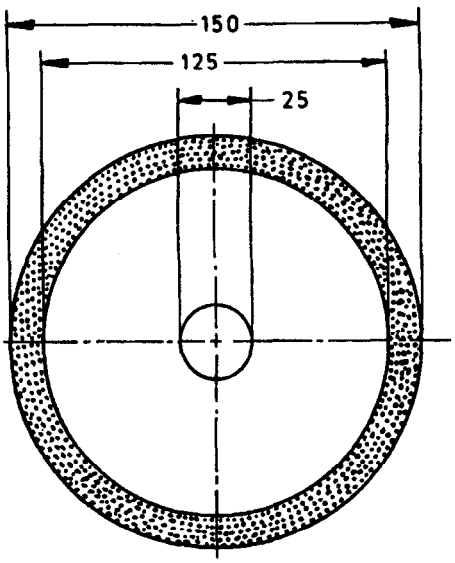
A-3.6 If the sample does not have a flat surface, the contact between the surface and the electrodes may be improved by first placing on each painted ring on the test piece, a sheet of metal foil cut to the same dimensions as the rings. The electrodes are then placed on the foil (*see* Note under **A-2.3**).

A-3.7 Connect the outer electrode to the earth or low voltage terminal of the measuring instrument and the inner electrode to the high voltage terminal. The leads should not touch each other, the test piece or any part of the apparatus except the terminals to which each is connected.



All dimensions in millimetres.

FIG. 2 ASSEMBLY FOR TESTING ELECTRICAL RESISTANCE



All dimensions in millimetres.

FIG. 3 DESIGN TO BE PAINTED ON TEST PIECE

A-3.8 Measure the resistance by applying the voltage for at least one minute.

A-3.9 Ensure when reading the resistance that it does not change appreciably when pressure is exerted over the electrodes. Take care not to breathe on the test piece as any condensation of moisture on the surface will falsify the results. Repeat the test on the other face of the test piece.

A-3.10 Expression of Results

The following results shall be recorded:

a) For each face of the test piece, the electrical resistance shall be expressed as the mean of the values noted for the two test pieces.

b) The electrical resistance of the two faces shall be reported separately.

ANNEX B

(*Clauses* 5.5.6.1 *and* 5.5.6.5)

FIRE RESISTANCE TEST

B-1 GENERAL

Two methods have been covered as follows:

Method 1 Barthel Burner's test

Method 2 Interim Flame method

The choice of method is optional, but consideraion should be given to the nature of service for which fire resistance test value may be sought.

B-2 CONDITIONING

Condition the test pieces at 27±2°C and 65±5 percent relative humidity for 48 hours prior to the testing subject to agreement between the purchaser and the supplier, the condition time may be curtailed to 24 hours.

B-3 METHOD 1 — DETERMINATION OF FIRE RESISTANCE CHARACTERISTICS BARTHEL BURNER METHOD

B-3.1 Apparatus

B-3.1.1 *Barthel Burner*

Barthel burner shown in Fig. 4 shall have a jet of 0.8 mm diameter with a flame gauze of aperture 0.50 mm over it. The diameter of the flame tube shall be 20 mm.

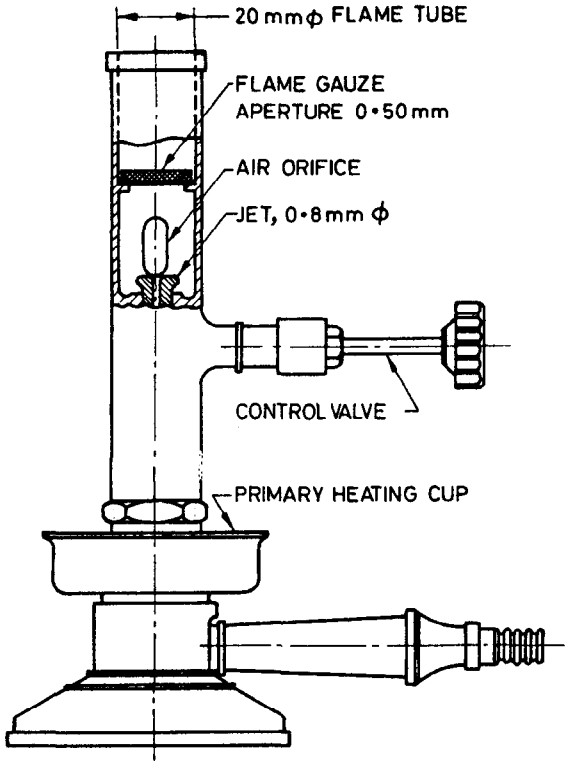


FIG. 4 BARTHEL BURNER

B-3.1.2 *Stand for Flame Test* (*see* Fig. 5).

A suitable test stand consists of a clamp and light steel framework to hold the Barthel burner and the test piece in the required position during the test. The frame is 450 mm wide and 750 mm high with feet about 300 mm long. The test piece is suspended from the top cross bar of the stand by means of a spring clip. The lower corner of the test piece is slipped into a simple fork formed by a longitudinal saw cut in the end of a steel strip. The steel strip shall not be larger than 9.5 mm wide and 3 mm thick. The fork is fixed to the stand and serves to hold the test piece steady during the test.

A rotating bracket is attached to the opposite side of the stand with arrangements for clamping the Barthel burner at an angle of 45°C to the vertical. The Barthel burner may secured to the bracket by means of a set screw passing through the bracket and engaging with a tapped hole arranged on the underside of the burner base or by other suitable means. By means of the bracket, the burner may be swung so that the flame either plays on the test piece or is well clear of it.

The fuel container for the burner is clamped on the side of the test cabinet so that the mean fuel level is approximately 750 mm above the base of the burner.

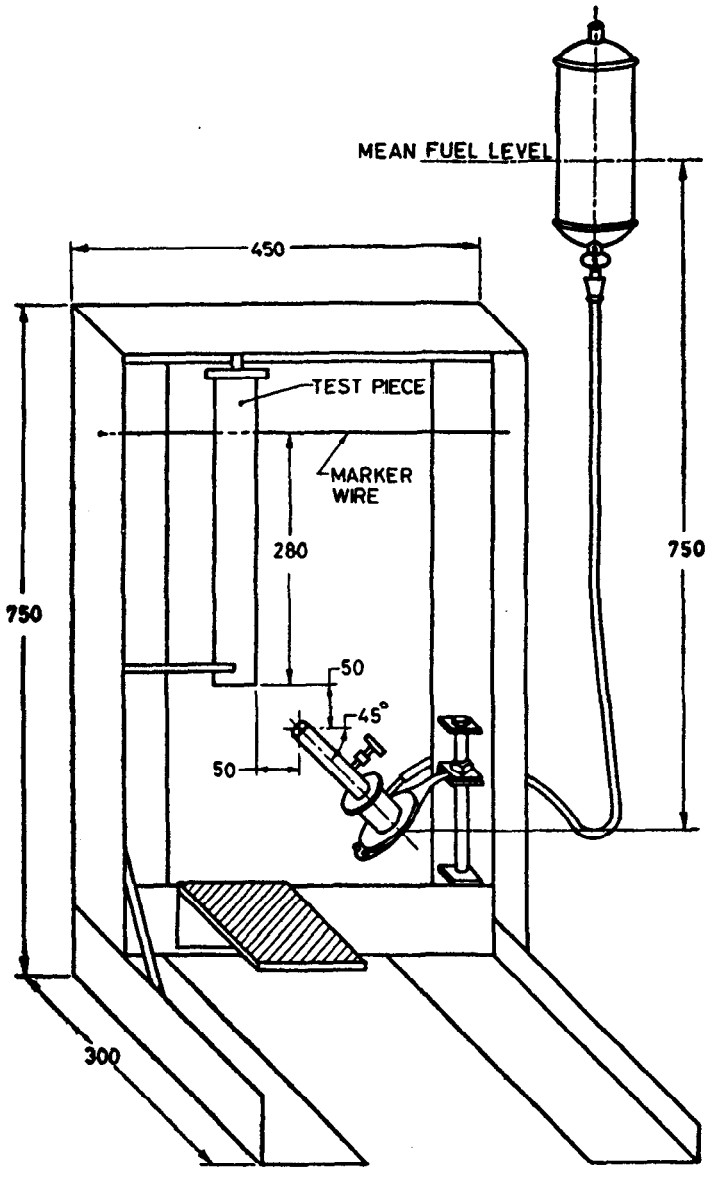
The position of the burner in its clamp is adjusted so that when in the test position, the centre of the burner mouth is 50 mm below and 50 mm to one side of the nearer lower corner of the test piece, with the flame burning in the plane of the test piece.

A small asbestos-covered table is fixed to the stand approximately 150 mm below the bottom edge of the test piece when in the test position. This table serves to catch any falling portion of the burning test piece.

A marker wire is stretched horizontally across the stand behind the test piece and is set 280 mm above the bottom edge of the test piece.

B-3.1.3 *Draught-Free Cabinet*

A draught-free cabinet illustrated in Fig. 6 inside which the test stand is placed to carry out the test, consists of a box with a dark interior, approximately 700 mm wide, 1 000 mm high and 600 mm deep with a 150 mm diameter hole at the top to allow the fumes to escape. The test stand is placed inside the cabinet and a hand hole (with flap) is provided at



All dimensions in millimetres.

FIG. 5 STAND FOR FIRE RESISTANCE TEST

the side of the cabinet to permit handling the burner. A sliding door with a panel of transparent non-ignitable plastic or similar material is provided on front of the cabinet.

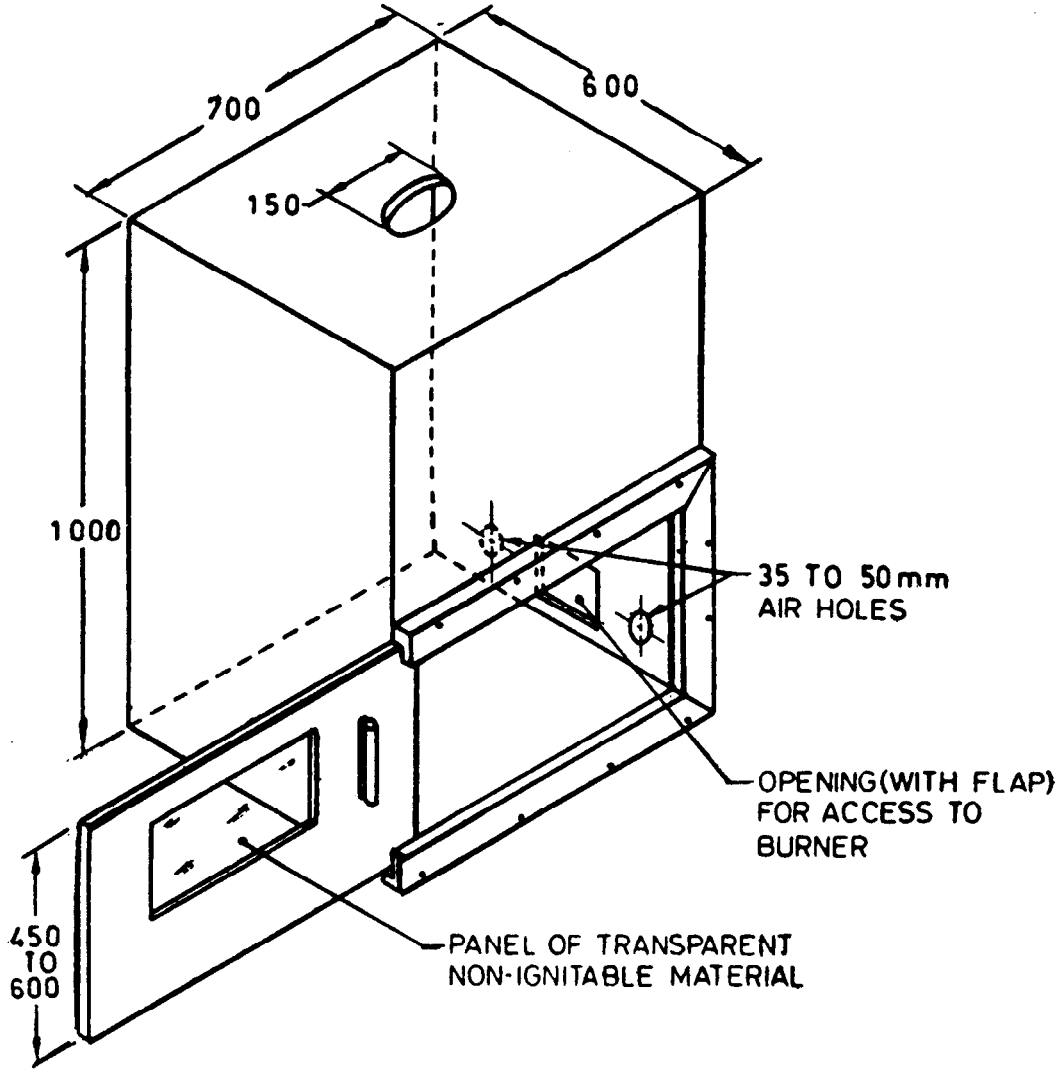
B-3.2 Conditioning of Test Specimens

Each of the six test pieces, 50 mm × 450 mm in size, shall in turn be bent around a fixed 5 mm diameter rod as shown at (a) in Fig. 7. Each test piece shall be pulled from one end to the other so that it is in the position shown at (b) in Fig. 7 and then back to the position shown at (a) in Fig. 7. During the whole operation, the test piece shall be in contact with 180° of the surface of the rod. The cycle of two movements shall then be repeated ten times for each test piece. Each test piece shall then be turned over and the procedure repeated to 10 complete cycles. All loose material shall then be shaken off the test pieces.

B-3.3 Test Conditions

B-3.3.1 The tests shall be made in subdued light in the draught-free cabinet.

B-3.3.2 The Barthel burner shall be supplied with fuel consisting of 95 percent (*v/v*) ethanol and 5 percent (*v/v*) methanol and the mean fuel level shall be approximately 750 mm above the base of the burner. The visible flame shall be adjusted to a height of 180 mm above the top of the burner with the latter in the vertical position. The adjustment of the flame height shall be made against the dark background of the draught-free enclosure.



All dimensions in millimetres.

FIG. 6 DRAUGHT-FREE CABINET

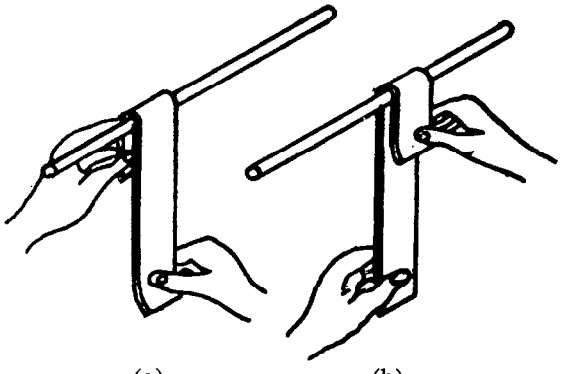


FIG. 7 METHOD OF CONDITIONING TEST SPECIMENS

B-3.3.3 The satisfactory operation of the burner shall be checked by holding a bare copper wire of 0.71 mm diameter and having a free length of not less than 100 mm at right angles to the axis of the burner. It shall be held in this position in the flame 50 mm above the top of the burner that the free end of the wire extends up to the edge of the flame ion the side remote from the supported end of the wire. If the wire takes more than 6 seconds to melt, the burner is not functioning properly for the purpose of the test.

B-3.4 Procedure

B-3.4.1 Six test pieces, each 50 mm × 450 mm, immediately after conditioning in accordance with **B-3.2** shall in turn be mounted in the test stand.

B-3.4.2 Each test piece shall be held in the burner flame for the prescribed time and the burner and the flame shall then be swung clear of the test piece. The six test pieces in each group shall in turn be held in the burner flame for 20 seconds.

B-3.4.3 The behaviour of each test piece shall be closely and continuously observed from the time the flame is first applied until at least 30 seconds after any flame or glow on the test piece is extinguished.

B-3.4.4 If satisfactory observations for the time taken by flame or glow to disappear are not possible to be made due to any of the six test pieces shrivelling or melting away during the 20 seconds exposure to burner flame, further tests on six more test pieces shall be carried out with the exposure reduced to 10 seconds. When, in accordance with the foregoing, the reduced exposure time of 10 seconds becomes applicable, this shall be stated in the test report.

B-4 METHOD 2 — DETERMINATION OF FIRE RESISTANCE CHARACTERISTICS INTERIM FLAME METHOD

B-4.1 Apparatus

B-4.1.1 A methylated spirit lamp of capacity 125 ml. The spirit lamp shall be supplied with 95 percent absolute alcohol and 5 percent methanol and the fuel level shall be half the capacity of the lamp.

B-4.1.2 The visible flame shall be 32 mm high when measured from the top of the ceramic/metallic wick holder to the top of the flame.

B-4.1.3 A suitable stand consisting of frame-work and clamps to hold the sample in the required position during the test as shown in Fig. 8.

B-4.1.4 A draught-free cabinet in which the test stand is placed to carry out the test.

B-4.2 Conditioning of Test Specimens

B-4.2.1 Each of the six test pieces, 76 mm × 356 mm in size, shall in turn be bent around a fixed 5 mm diameter rod as shown at (a) in Fig. 7, shall be pulled from one end to the other so that it is in the position shown at (b) in Fig. 7 and then back to the position shown at (a) in Fig. 7. During the whole operation, the test piece shall be in contact with 180° of the surface of the rod. The cycle of two movements shall then be repeated ten times for each test piece. Each test piece shall then be turned over and the procedure repeated to 10 complete cycles. All loose material shall then be shaken off the test pieces.

B-4.2.2 *Test Conditions*

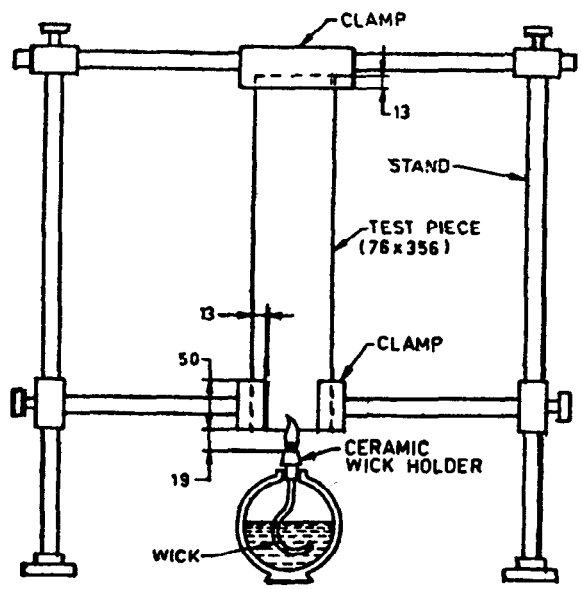
B-4.2.3 The test shall be made in subdued light in a draught-free cabinet.

B-4.2.4 *Procedure*

B-4.2.4.1 Six test pieces, each 76 mm × 356 mm, immediately after conditioning in accordance with B-4.2.1 shall be suspended from the clamp so that they may hang vertically with their lower end held by horizontal clamp; one on each side in such a way as to prevent movement of the test piece during the application of the flame. The lower edge of the clamps to coincide with the lower edge of the test piece and overlap the edges by 13 mm.

B-4.2.4.2 The flame is positioned so that the top of the ceramic/metallic wick holder is 19 mm below the middle of the lower edge of the test piece.

B-4.2.4.3 Each test piece shall be held in the flame for 10 seconds, and the lamp and the flame shall then be withdrawn clear of the test piece.



All dimensions in millimetres.

FIG. 8 APPARATUS USED FOR THE INTERIM FLAME TEST

ANNEX C

(*Clauses* 5.6.1, 5.6.2 *and* 5.6.3)

TESTS FOR ASSEMBLED DUCT

C-1 PREPARATION OF DUCTINGS FOR TEST

C-1.1 Four lengths of ducting as supplied of the size to be tested, shall be selected at random and shall be assembled to form a duct. At each end of the duct shall be fitted a cuff of tubing 2 m long having one end fitted with the normal joint-ring and

having the other end secured, without leakage, to a cylindrical drum sealing the ends of the duct. One sealing drum shall have a suitable connection for admitting air from the duct. The other sealing drum should have a suitable connection for measuring the pressure inside the duct. The duct shall be suspended horizontally by means of the suspension eyelets.

C-1.1.1 *Pressure Test*

Air at ambient temperature shall be injected into the duct at a rate sufficient to maintain a pressure inside the duct of at least 625 mm of water column above atmospheric pressure for a period of at least five minutes.

C-1.1.2 *Leakage Test*

Air at atmospheric temperature shall be injected into the duct and the rate of free air flow shall be determined at operative pressure necessary to maintain an air pressure of 623 mm of water column above atmospheric pressure in the duct.

C-1.1.2.1 After the initial test, the duct shall be completely dismantled and the test repeated twice with the lengths of ducting reassembled in random order.

C-1.1.3 *Suction Test*

The semi-rigid ducting shall be fully extended in a straight line and the ends rigidly held at that length, air at atmospheric temperature shall be withdrawn from the duct at a rate sufficient to maintain a pressure inside the duct as specified in **5.6.3** for a period of at least 5 minutes.

C-1.1.3.1 The air in the ducting shall be cycled from atmospheric pressure to the test level at least for 5 minutes.

ANNEX D

(*Clause* 7.1)

SAMPLING OF VINYL COATED AND SEMI-RIGID VENTILATION DUCTING

D-1 SCALE OF SAMPLING

D-1.1 Lot

In any consignment, all the vinyl coated flexible or semi-rigid ventilation ductings of the same grade and size are manufactured under similar conditions of production shall be grouped together to constitute a lot.

D-1.1.1 Samples shall be tested from each lot for ascertaining conformity of the material to the requirements of this specification.

D-1.2 The number of ductings to be chosen from the lot shall depend on the number of ductings in the lot and shall be as given in Table 3.

Table 3 Scale of Sampling
(*Clauses* D-1.2 *and* D-1.3)

No. of Ductings in the Lot (N) (1)	No. of Ductings to be Selected (n) (2)
Up to 50	2
51 to 100	3
101 to 200	4
201 to 300	5
301 and above	7

D-1.2.1 These ductings shall be selected at random and in order to ensure the randomness of selection, a random number table as agreed to between the purchaser and the supplier shall be used. In case such a table is not available, the following procedure shall be adopted:

Starting from any ducting in the lot, count them as 1, 2, 3, up to r and so on one order where r is the integral part of N/n. Every rth ducting thus counted shall be taken to constitute the sample for test.

D-1.3 In case the ductings are packed in packages, each containing more than one ducting, number of packages, equal to the number of ducting to be selected as given in col 2 of Table 3, shall first be selected at random and from each of these packages, one ducting shall be taken to give the required number of ductings for the sample.

D-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

D-2.1 Each of the ductings selected as in **D-1.2** shall be tested for the requirements given for construction, assembled duct and joint rings.

D-2.1.1 The lot shall be considered to satisfy the requirements for these characteristics if each of the ductings tested in **D-2.1** satisfied all these requirements.

D-2.2 From each of the ductings selected according to **D-1.2**, one m length shall be cut, leaving at least 0.25 m from both ends. The test specimens

shall be cut from this one m length and tested for the requirements given in **5.4** and **5.5**.

D-2.3 The lot shall be considered to satisfy all the requirements for finished fabric if each of the test piece satisfies all these requirements.

NOTES

1 Since it is difficult to remove spiral support in semi-rigid ventilation ducting for determination of mass of finished fabrics, the manufacturer shall provide extra length of the product (without spiral support) for testing to be carried out.

2 Manufacturer shall provide an additional joint portion of the semi-rigid ventilation ducting for testing for requirements given in **5.5.3**, **5.5.4** and **5.6.1**. Irrespective of the methodology used for joining the ducting, the above stated properties shall not be adversely affected on the joint portion.

(*Continued from second cover*)

JIS M 7102 : 1983 Vinyl coated — cloth tubes for ventilation. Japanese Industrial Standards Committee.

SABS 1287 (Part 1) : 1980 Flexible ducting. South African Bureau of Indian Standards.

SABS 1287 (Part 2) : 1981 Brattice, unsupported. South African Bureau of Indian Standards.

NCB No. 154/1989 Flexible ventilation ducting made from treated fabrics, issued by the National Coal Board, London.

NCB No. 586/1989 Semi-rigid ventilation ducting made from treated fabrics, issued by National Coal Board, London.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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